

# A plausible molecular mechanism to explain the widely observed near-IR continuum emission: recurrent fluorescence

O. Lacinbala<sup>1</sup>, F. Calvo<sup>2</sup>, C. Falvo<sup>1,2</sup>, P. Parneix<sup>1</sup>, A. Simon<sup>3</sup>, and et T. Pino<sup>1</sup>

<sup>1</sup> *Université Paris-Saclay, CNRS, Institut des Sciences Moléculaires d'Orsay (ISMO), Orsay, France*

<sup>2</sup> *Université Grenoble-Alpes, CNRS, LIPhy, Grenoble, France*

<sup>3</sup> *Laboratoire de Chimie et Physique Quantiques, Fédération FeRMI, Université de Toulouse, CNRS, France*

Large interstellar molecules are known to efficiently absorb light in the UV-visible range and convert this radiation into infrared emission. Such a mechanism has been introduced almost 40 years ago to qualitatively explain the near-IR blackbody-like emission observed toward reflection nebulae, unaccounted for by simple reflection of light. This process gave the foundation of the mechanism for the so-called PAH hypothesis formulated shortly after. However, no specific carriers have been identified so far for the near-IR blackbody-like emission, whereas it has been detected in some reflection nebulae [1] and several planetary nebulae [2-4] shortward of 5  $\mu\text{m}$ .

So far, investigations on near-IR continuum emission estimated the carriers size via classical thermodynamics. In the present work, we suggest an alternative explanation to this near-IR continuum emission using a more realistic molecular approach that includes a photophysical mechanism that has been largely overlooked by the astrophysical community, namely *recurrent fluorescence* (RF), also known as *Poincaré fluorescence* [5].

In the present work, we provide a kinetic modeling over long time scales of radiative cooling through RF and vibrational emission (VE) based on a broad structural database of carbon cluster cages containing between 24 and 60 atoms and undergoing irradiation from spectral distributions taken as 20 000 K stellar blackbody. RF has been shown to be efficiently compete with VE in isolated conditions [6]. Our modeling relies on very limited numbers of empirical parameters and on molecular structures generated using a systematic multiscale approach [7, 8], together with the determination of vibrational [8] and electronic spectra [9]. All RF and VE rate constants were calculated assuming an ergodic redistribution of internal energies among available vibronic states.

Our main result is that the continuum emissions detected in the near-IR range could be explained by the RF mechanism originating from carbon clusters with sizes similar to those of C<sub>60</sub> and C<sub>42</sub> and possessing cage-like structures (low asphericity and high sp<sup>2</sup> content), graphene-like carbon flakes appearing as possible contributors too, though to a lesser extent [10].

## References

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